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PHYTOTOXICOLOGY 1996 INVESTIGATION:

K & E LANDFILL

SARNIA

SEPTEMBER 1998

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K & E LANDFILL

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Report No: SDB-001-3511-97

INTRODUCTION

The Phytotoxicology Section, Standards Development Branch of the Ontario Ministry of Environment and Energy received a request from the Sarnia District Office for a study of the terrestrial environment in the vicinity of the K & E Landfill in Sarnia. This study wasrequested in order to establish a baseline for the site which obtained a large increase in the rate of deposit. An amendment to the Certificate of Approval in 1995 allowed the increase from 100 tons/day average and 200 tons/day maximum to 1000 tonnes/day average and 1500 tonnes/day maximum. The site is operated by Canadian Waste Services of Ontario Inc.

The K & E Blackwell Road Landfill is located on Part of Lots 47, 48, 49, 50 and 51 in the City of Sarnia. The site was operated as an aggregate (sand and gravel) pit from the 1950s to the early 1980s. The site is bordered to the north and west by an abandonned railroad line. The right-of-way is owned by the City of Sarnia and is known as the Howard Watson Trail. A new residential subdivision lies immediately beyond the Trail. The area south of the landfill has private residences and a retirement home. The area to the east includes large ponds created by the extraction of sand and gravel. The soils of the whole area reflect the sand deposits from which the aggregates were extracted.

METHODS

After an intial tour of the area, a network of soil sampling sites were selected around the landfill. These are shown in the attached map.

At each site, soil samples 0-5 cm in depth were collected in duplicate [1]. The samples were placed in labelled plastic bags. These samples were returned to the Phytotoxicology Laboratory for processing [2]. At each site, readily visible plant species were noted.

The soils were air-dried, crushed to pass through a 45 mesh sieve and stored in glass bottles. The samples were forwarded to the Laboratory Services Branch, Ministry of the Environment and Energy for chemical analysis. The analytical tests included beryllium (Be), magnesium (Mg), aluminum (Al), calcium (Ca), Vanadium (V), chromium (Cr), manganese (Mn), iron (Fe), cobalt (Co), nickel (Ni), copper (Cu), zinc (Zn), molybdenum (Mo), cadmium (Cd), barium, Ba), lead (Pb), strontium (Sr), Boron (B total and hot water extractable), sodium (Na), chloride (Cl), and sulphur (S).

The data were compared with OTR_{98} (Ontario Typical Range) guidelines. The derivation of these guidelines are shown in Appendix II. The data are also compared to the MOEE soil Clean-up Criteria. These guidelines are effects-based and do not imply that an exceedence requires action. Rather, they are intended for use when industrial properties are decommissioned and redeveloped for parkland and residential land use.

Notes on soil sampling sites in the vicinity of the K & E Landfill, Sarnia, Aug 29, 1996

Site	Location	Observations
1	Park on east side of Pullen Street	Open mowed turf grass
2	North side of Blackwell Road about 200 metres west of gate to landfill	Roadside with mowed lawn
3	North side of Blackwell Road at southwest corner of Versa Care Centre retirement home	Mowed lawn with semi-mature landscape trees
4	North side of Blackwell Road about 200 metres west of Modeland Road	Roadside right-of-way
5	Gate on Howard Watson Trail south of Cathcart Blvd about 300 metres west of Modeland Road	Abandonned railroad with unmowed grass
6	Un-named park between Cathcart Blvd and Howard Watson Trail immediately north of landfill	Abandonned railroad with unmowed grass
7	Howard Watson Trail about 500 metres southwest of Site 6 near peizometer station	Abandonned railroad with unmowed grass
8	Howard Watson Trail in vicinity of memorial plaque off Blackwell Sideroad (Control)	Abandonned railroad with unmowed grass

Soil at all sites consisted of a dry coarse sand

RESULTS

The chemical analysis results are presented in the attached table. Except for a few cases discussed below, the majority of elemental concentrations were well within the OTR_{98} guidelines for the respective elements. The Clean-up Criteria were not exceeded at any of the sample sites.The cases where the guidelines were exceeded included zinc (Sites 2,3, and 5), molybdenum (Site 2) and sulphur (Sites 3, 5 and 8). In each of these cases, the respective concentrations only marginally exceeded the OTR_{98} guidelines. In no case are the reported concentrations considered to be toxic to vegetation.

Element	Site				OTR_{98}
	2	3	5	8	
Zinc	170	150	160		140
Molybdenum	1.0				0.9
Sulphur %		0.105	0.165	0.100	0.097

There is no evidence that the pattern of elevated chemical element concentrations is directly related to the landfill. Site 2, 3 and 4 are close and equally exposed to Blackwell Road, a possible source of the elevated chemical concentrations. However, only Sites 2 and 3 are near the gate to the landfill. From this information, there is a suggestion that truck traffic (and associated dust) near the gate may has caused the higher concentrations. This does not explain the elevation in zinc and sulphur concentrations at Site 5 and sulphur at the control location (Site 8) which is not likely impacted by traffic on Blackwell Road and is somewhat removed from the landfill.

The plant species seen at each site are included in Appendix I. The list is not intended to be comprehensive but does illustrate that there are a number of Provincially significant species present in the study area. Additional rare species are known to occur along the Howard Watson Trail and could have been present but overlooked during the site visit. The species highlighted in Appendix I are indicators of Carolinian and oak savannah habitat which have restricted ranges in Ontario. At present, none of the species indicated are on the endangered list; however, because of their restricted distribution, they should receive appropriate attention to avoid this possibility.

SUMMARY

A Phytotoxicology investigation was conducted in the vicinity of the K & E Landfill in Sarnia on August 29, 1996. Slightly elevated concentrations of zinc, molybdenum and/or sulphur were measured in soil at three locations. No clear pattern associating the elevated concentrations with the landfill could be made. A number of plant species that are rare or of limited distribution occur in the vicinity of the landfill.

REFERENCES

1. McIlveen, W.D., and D.L. McLaughlin. 1993. Field investigation manual Part 1: General methodology. Report No. HCB-014-3511-93.

2. McIlveen, W.D., and D.L. McLaughlin. 1993. Field investigation manual Part 2A: General methodology. Report No. HCB-015-3511-93.

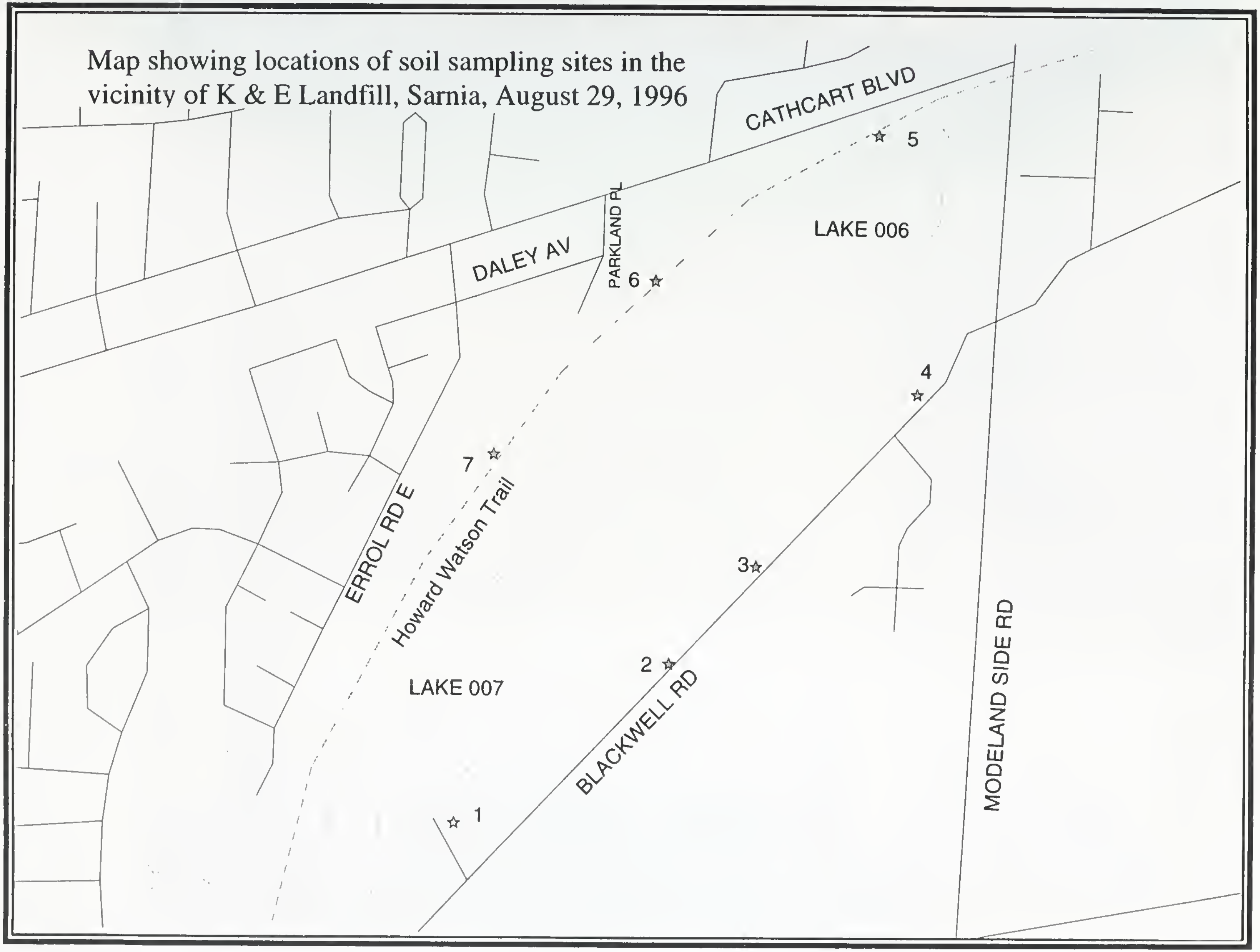
3. Ontario Ministry of the Environment and Energy. 1993. Ontario Typical Range of chemical parameters in soil, vegetation, moss bags and snow. Report No. HCB-151-3512-93.

Concentrations of chemical elements in soil collected in the vicinity of the K & E Landfill, Sarnia- Aug 29, 1996

Element	Site								OTR_{98}	Soil Clean-up
	1	2	3	4	5	6	7	8		
Chloride	9.0	12.5	12.0	12.5	6.5	5.0	1.5	6.5	220.0	NA
Beryllium	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5	0.97	1.2
Magnesium	2,550	13,000	11,500	11,000	4,200	8,300	7,400	4,850	16,000	NA
Aluminum	5,300	7,150	8,450	4,050	7,800	7,350	4,650	3,350	27,000	NA
Calcium	6,550	43,500	30,500	27,600	12,000	30,500	16,300	20,750	58,000	NA
Vanadium	18	21	24	16	33	20	17	16	71	200
Chromium	10	16	16	9	16	12	9	10	62	750
Manganese	260	495	580	260	835	345	320	335	1,300	NA
Iron	9,300	12,000	13,000	7,450	20,500	11,000	9,600	20,500	33,000	NA
Cobalt	3.0	4.6	5.5	2.8	7.1	4.4	3.2	4.6	17.0	40.0
Nickel	7.8	14.5	13.5	7.8	17.5	12.5	8.7	13.0	32.0	150.0
Copper	12	25	24	12	36	15	13	61	65	225
Zinc	62	170	150	80	160	67	54	105	140	600
Molybdenum	0.5	1.0	0.6	0.5	0.8	0.6	0.5	0.6	0.9	40.0
Cadmium	0.3	0.5	0.8	0.2	0.8	0.4	0.2	0.4	0.8	12.0
Barium	33	49	55	22	62	42	25	33	180	750
Lead	30	71	75	37	58	22	19	74	98	200
Strontium	11	43	31	40	24	28	24	37	78	NA
Boron Total	2.7	6.8	8.0	5.4	5.3	4.3	2.8	4.6	30.0	NA
Boron Ext	0.38	0.5	0.59	0.42	0.33	0.38	0.17	0.33	1.5	1.5
Sodium	47	115	115	105	97	76	72	95	910	NA
Sulphur %	0.071	0.065	0.105	0.057	0.165	0.061	0.039	0.100	0.097	NA

Data reported are means of duplicate sample in ug/g unless indicated otherwise
Shaded cells indicate that values exceed respective OTR_{98} guideline for Old Urban Parkland (See Appendix II)
MOEE Soil Clean-up criteria for parkland/residential landuse

Map showing locations of soil sampling sites in the vicinity of K & E Landfill, Sarnia, August 29, 1996



Appendix I - Plant species noted in the vicinity of the K & E Landfill

Species	Scientific Name	Site Number							
		1	2	3	4	5	6	7	8
Eastern White Cedar	*Thuja occidentalis*		x	x		x	x		
Juniper	*Juniperus sp.*						x		
White Spruce	*Picea glauca*			x					
Norway Spruce	*Picea abies*			x			x		x
Eastern White Pine	*Pinus strobus*								x
Red Pine	*Pinus banksiana*					x			
Balsam Poplar	*Populus balsamifera*						x		
Trembling Aspen	*Populus tremuloides*						x		
Eastern Cottonwood	*Populus deltoides*		x			x	x	x	
Black Elder	*Sambucus canadensis*					x			
Red Oak	*Quercus rubra*		x	x		x	x	x	x
Bur Oak	*Quercus macrocarpa*		x			x			
Shagbark Hickory	*Carya ovata*			x					
Bitternut Hickory	*Carya cordiformis*		x						
Black Walnut	*Juglans nigra*			x		x			x
Manitoba Maple	*Acer negundo*	x		x					x
Silver Maple	*Acer saccharinum*	x		x			x		
Norway Maple	*Acer platanoides*	x					x		
Apple	*Malus pumila*				x			x	x
Pin Cherry	*Prunus pensylvanica*							x	
Sour Cherry	*Prunus cerasus*	x							
Black Locust	*Robinia pseudo-acacia*							x	
Horse Chestnut	*Aesculus hippocastaneum*						x		
Little Leaf Linden	*Tilia cordata*						x		
White Ash	*Fraxinus americana*		x	x					
White Mulberry	*Morus alba*	x		x			x		
Shining Willow	*Salix lucida*							x	
Sandbar Willow	*Salix exigua*						x		
Lilac	*Syringa vulgaris*								x
Privet	*Ligustrum vulgare*			x					
Tartarian Honeysuckle	*Lonicera tatarica*			x					
Sumac	*Rhus typhina*				x	x	x	x	x
Fragrant Sumac	*Rhus aromatica*						x		
Canada Plum	*Prunus nigra*			x					
Hawthorn	*Crataegus sp.*				x				
Red Raspberry	*Rubus idaeus*								x
Wild Grape	*Vitis riparia*	x			x		x	x	x

Species	Scientific Name	Site Number							
		1	2	3	4	5	6	7	8
Canada Wild Rye	*Elymus canadensis*					x			
Big Bluestem	*Andropogon gerardii*					x	x		x
Little Bluestem	*Schizachyrium scoparium*					x	x		x
Round-headed Bushclover	*Lespedeza capitata*					x			
Green Milkweed	*Asclepias viridiflora*					x			
Butterflyweed	*Asclepias tuberosa*								x
Flowering Spurge	*Euphorbia corollata*								x
Showy Tick-trefoil	*Desmodium canadense*								x
Rigid Goldenrod	*Solidago rigida*					x	x		x
Heath Aster	*Virgulus ericoides*					x			
Smooth Aster	*Aster laevis*					x			

Shaded cells indicate species associated with Carolinian or oak savannah habitats

Derivation and Significance of the Ontario Ministry of Environment and Energy (MOEE) "Ontario Typical Range" of Chemical Parameters in Soil, Vegetation, Moss bags and Snow

The MOEE "Ontario Typical Range" (OTR) guidelines are being developed to assist in interpreting analytical data and evaluating source-related impacts on the terrestrial environment. The OTRs are used to determine if the level of a chemical parameter in soil, plants, moss bags, or snow is significantly greater than the normal background range. An exceedence of the OTR_{98} (*the OTR_{98} is the actual guideline number*) may indicate the presence of a potential point source of contamination.

The OTR_{98} represents the expected range of concentrations of chemical parameters in surface soil, plants, moss bags, and snow from areas in Ontario not subjected to the influence of known point sources of pollution. The OTR_{98} represents 97.5 percent of the data in the OTR distribution. This is equivalent to the mean plus two standard deviations, which is similar to the previous MOEE "Upper Limit of Normal" (ULN) guidelines. In other words, 98 out of every 100 background samples should be lower than the OTR_{98}.

The OTR_{98} may vary between land use categories even in the absence of a point source of pollution because of natural variation and the amount and type of human activity, both past and present. Therefore, OTRs are being developed for several land use categories. The three main land use categories are Rural, New Urban, and Old Urban. Urban is defined as an area that has municipal water and sewage services. Old Urban is any area that has been developed as an urban area for more than 40 years. Rural is all other areas. These major land use categories are further broken into three subcategories; Parkland (which includes greenbelts and woodlands), Residential, and Industrial (which includes heavy industry, commercial properties such as malls, and transportation rights-of-way). Rural also includes an Agricultural category.

The OTR guidelines apply only to samples collected using standard MOEE sampling, sample preparation, and analytical protocols. Because the background data were collected in Ontario, the OTRs represent Ontario environmental conditions.

The OTRs are not the only means by which results are interpreted. Data interpretation should involve reviewing results from control samples, examining all the survey data for evidence of a pattern of contamination relative to the suspected source, and where available, comparison with effects-based guidelines. The OTRs are particularly useful where there is uncertainty regarding local background concentrations and/or insufficient samples were collected to determine a contamination gradient. OTRs are also used to determine where in the anticipated range a result falls. This can identify a potential concern even when a result falls within the guideline. For example, if all of the results from a survey are close to the OTR_{98} this could indicate that the local environment has been contaminated above the *anticipated average,* and therefore the pollution source should be more closely monitored.

The OTRs identify a range of chemical parameters resulting from natural variation and normal human activity. ***As a result, it must be stressed that values falling within a specific OTR_{98} should not be considered as acceptable or desirable levels; nor does the OTR_{98} imply toxicity to plants, animals or humans.*** Rather, the OTR_{98} is a level which, if exceeded, prompts further investigation on a case by case basis to determine the significance, if any, of the above normal concentration. Incidental, isolated or spurious exceedences of an OTR_{98} do not necessarily indicate a need for regulatory or abatement activity. However, repeated and/or extensive exceedences of an OTR_{98} that appears to be related to a potential pollution source does indicate the need for a thorough evaluation of the regulatory or abatement program.

The OTR_{98} supersedes the Phytotoxicology ULN guideline. The OTR program is on-going. The number of OTRs will be continuously updated as sampling is completed for the various land use categories and sample types.